

Use-specific Recalculation of 2016 Cadmium Criteria for Warmwater Classification, Title 117-
Nebraska Surface Water Quality Standards.

Warmwater cadmium criteria were recalculated using the species deletion method and the most recent species acute and chronic values from the 2016 cadmium criteria document (USEPA, 2016). All fish and corresponding toxicity values from the family Salmonidae were excluded from the calculations except Rainbow trout (*Oncorhynchus mykiss*). Rainbow trout remained in the calculations to satisfy the eight-family rule of EPA's 1985 Guidelines for Deriving Numerical Criteria (USEPA, 1985) and EPA's Deletion Process (USEPA, 2013).

Acute Recalculation

The acute criterion recalculation used all species mean acute values (SMAVs) and genus mean acute values (GMAVs) from Table 7 of the 2016 cadmium document except the following:

GMAV (µg/L total)	Species	Common Name	Reason for Deletion
4.190	<i>Salvelinus sp.</i>	Bull/Brook Trout	Salmonidae
5.642	<i>Salmo trutta</i>	Brown Trout	Salmonidae
6.141	<i>Oncorhynchus sp.</i>	Trout/Salmon	Salmonidae*
>15.72	<i>Prosopium williamsoni</i>	Mountain Whitefish	Salmonidae
651.300	<i>Coregonus clupeaformis</i>	Lake Whitefish	Salmonidae

*Deletion does not reduce N since Rainbow trout were retained to satisfy eight-family rule.

Since there were 75 genera in the original 2016 dataset used to calculate the acute criterion, these deletions reduced the N to 71 for recalculation purposes. These deletions left the following four most sensitive GMAVs for the recalculation:

Rank	GMAV (ug/L total)	Species	Common	SMAV (ug/L total)
4	23.000	<i>Hyaella azteca</i>	Amphipod	23.000
3	5.931	<i>Morone saxatilis</i>	Striped bass	5.931
2	4.411	<i>Cottus bairdii</i>	Mottled sculpin	4.418
		<i>Cottus confusus</i>	Shorthead sculpin	4.404
1	3.727*	<i>Oncorhynchus mykiss</i> *	Rainbow trout*	3.727*

*Included as most sensitive salmonid to meet eight-family rule.

Recalculation of the acute warmwater cadmium criterion is as follows:

GMAV N	Rank (R)	GMAV	Ln(GMAV)	Ln(GMAV)²	P=R/(N+1)	sqrtP
71	4	23.000	3.135494	9.831324	0.055556	0.235702
	3	5.931	1.780193	3.169087	0.041667	0.204124
	2	4.411	1.484101	2.202557	0.027778	0.166667
	1	3.727	1.315604	1.730813	0.013889	0.117851
Sum:		71	7.715392	16.93378	0.138889	0.724344

Which results in:

S=	16.30304
L=	-1.02341
A=	2.622066
FAV=	13.764

Where, S=slope, L=intercept, A=ln(FAV), FAV=final acute value

These data resulted in a final acute value (FAV) of 13.764. The recalculation used the published toxicity vs. hardness slope value (m_a) of 0.9789. At a hardness of 100, the m_a and FAV produce an exponent adjustment factor (b_a) of -2.579 using the following equation:

$$b_a = \ln\left(\frac{FAV}{2}\right) - (m_a * \ln(hardness))$$

For hardness-based criteria, the Criterion Maximum Concentration (CMC) is expressed as an equation in the form of:

$$CMC = e^{m_a * \ln(hardness) + b_a}$$

The resulting recalculated CMC equation for cadmium is:

$$CMC = e^{(0.9789 * \ln(hardness)) - 2.579}$$

At a hardness of 100, the recalculated warmwater Criterion Maximum Concentration (CMC) for total cadmium is 6.88, compared to EPA's 2016 freshwater acute recommendation using all salmonid data of 1.9.

The criterion to be adopted in Title 117 is expressed as dissolved cadmium instead of total cadmium. The adjustment from total to dissolved uses EPA's published acute conversion factor (ACF) that is equation based:

$$ACF = 1.136672 - [\ln(hardness) * 0.041838] \quad (\text{USEPA, 2016})$$

The dissolved acute warmwater criterion recommended for adoption in Title 117 is equation-based and will take the form of:

$$(ACF)e^{(0.9789 * \ln(hardness)) - 2.579}$$

Chronic Recalculation

A chronic criterion recalculation followed the same procedure of excluding all salmonids except Rainbow trout (*Oncorhynchus mykiss*). Since there were 20 genera in the original 2016 dataset used to calculate the chronic criterion, these deletions reduced the N to 18 for recalculation purposes. These deletions did not change the four most sensitive GMCVs for the recalculation; thus, the only change from EPA's 2016 cadmium criteria effected by the recalculation was to reduce N from 20 to 18. The lower N produced an FCV of 0.757 compared to EPA's FCV of 0.79. This lower FCV results in a lower CCC and lower chronic criterion than EPA's recommended value; hence, the equation proposed for the Title 117 warmwater chronic

cadmium criterion will be based on EPA's 2016 freshwater chronic recommendation for total cadmium.

$$CCC = e^{(0.7977 \cdot \ln(\text{hardness})) - 3.909}$$

Since the Title 117 criterion is expressed as dissolved cadmium, it will use EPA's published chronic conversion factor (CCF) that is equation based as follows:

$$CCF = 1.101672 - [\ln(\text{hardness}) * 0.041838] \quad (\text{USEPA, 2016})$$

The dissolved acute warmwater criterion recommended for adoption in Title 117 is equation-based and will take the form of:

$$(CCF)e^{(0.7977 \cdot \ln(\text{hardness})) - 3.909}$$

References

- USEPA, 1985. Guidelines for Deriving Numerical National Water Quality Criteria for the Protection Of Aquatic Organisms and Their Uses. Office of Research and Development. PB85-227049.
- USEPA, 2013. Revised Deletion Process for the Site-Specific Recalculation Procedure for Aquatic Life Criteria. Office of Water. EPA-823-R-13-001, April 2013,
- USEPA, 2016. Aquatic Life Ambient Water Quality Criteria: Cadmium – 2016. Office of Water. EPA-820-R-16-002, March 2016.

From: [Fleisig, Erica](#)
To: [Voelker, Nicole](#)
Subject: FW: 2016 Cd recommended criteria
Date: Thursday, May 2, 2019 9:52:58 AM

From: Elias, Mike
Sent: Thursday, May 2, 2019 7:29 AM
To: Fleisig, Erica <Fleisig.Erica@epa.gov>
Subject: FW: 2016 Cd recommended criteria

From: Elias, Mike
Sent: Wednesday, August 02, 2017 8:43 AM
To: Bender, John <john.bender@nebraska.gov>
Cc: Lavaty, Ann <Lavaty.Ann@epa.gov>
Subject: RE: 2016 Cd recommended criteria

John,

I will be glad to take a look at your recalculations and will get back to you.

Thank you,
Mike

From: Bender, John [<mailto:john.bender@nebraska.gov>]
Sent: Wednesday, July 26, 2017 4:33 PM
To: Elias, Mike <Elias.Mike@epa.gov>
Cc: Lavaty, Ann <Lavaty.Ann@epa.gov>
Subject: RE: 2016 Cd recommended criteria

Mike,

I went ahead and recalculated Cd for our warmwater classification using the 1985 methods as modified by the "Revised Deletion Process" with the 2016 data. The attached documents (docx and xlsx) show my assumptions, methods, and calculations. Our regulatory revision process is currently on hold including the move to update Cd according to the 2016 304(a) document, but I would appreciate your review of my work. Hopefully, when our reg. revision is restarted, I will be able to drop in the new Cd criteria (304(a) recommended for coldwater classification, recalculation for warmwater classification).

Thanks,

John F. Bender

Water Quality Standards Coordinator
Nebraska Department of Environmental Quality
1200 N Street, P.O. Box 98922
Lincoln, NE 68509-8922
Phone: [REDACTED]

From: Elias, Mike [<mailto:Elias.Mike@epa.gov>]
Sent: Thursday, June 22, 2017 7:26 AM
To: Bender, John
Subject: RE: 2016 Cd recommended criteria

I just wanted to update you and let you know that we are working on your question about cadmium and I expect to have feedback for you soon.

Thanks,
Mike

From: Bender, John [<mailto:john.bender@nebraska.gov>]
Sent: Wednesday, June 14, 2017 2:33 PM
To: Elias, Mike <Elias.Mike@epa.gov>
Subject: RE: 2016 Cd recommended criteria

Thanks.

John F. Bender
Water Quality Standards Coordinator
Nebraska Department of Environmental Quality
1200 N Street, P.O. Box 98922
Lincoln, NE 68509-8922
Phone: [REDACTED]

From: Elias, Mike [<mailto:Elias.Mike@epa.gov>]
Sent: Wednesday, June 14, 2017 1:30 PM
To: Bender, John
Cc: Elias, Mike
Subject: RE: 2016 Cd recommended criteria

Thank you for your email. I wanted to let you know that I am out of the office for the next several days. I will take a close look at your questions early next week, when I am back, and can get back to you with my thoughts at that time.

Regards,
Mike

From: Bender, John [<mailto:john.bender@nebraska.gov>]
Sent: Wednesday, June 14, 2017 12:24

To: Elias, Mike <Elias.Mike@epa.gov>

Subject: 2016 Cd recommended criteria

Nebraska is looking at incorporating the new Cd criteria equations into its WQS. This would result in a slight decrease in our criterion for acute toxicity and an increase in our criterion for chronic toxicity for coldwater aquatic life. However, when we established our last Cd revision in 2002, we performed a species recalculation for warmwater aquatic life (salmonids absent), which is the majority of stream and lake types in Nebraska. The acute equation results in a less stringent acute criterion than the national recommendation from 2001. These criteria were approved by EPA with our 2002 triennial review submission.

Our current equation uses all of EPA's recommended factors for hardness calculation and m_a but uses -2.849 for b_a . This results in a value at hardness of 100 mg/L of 5.9 instead of the 2.0 national value. We would like to explore a similar recalculation for the 2016 recommendations.

The 2002 warmwater recalculation used a spreadsheet model from EPA that had all the species, SMAVs, GMAVs, and SMACRs already populated, with an option to delete species. It then calculated a new b_a value (and b_c which we did not use because it resulted in a value more stringent than national criteria) for our warmwaters.

Is such a recalculation still valid?

Is such a spreadsheet model available, or will I need to do the calculations by hand?

Thanks for your help.

John F. Bender
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From: [Fleisig, Erica](#)
To: [Voelker, Nicole](#)
Subject: FW: 2016 Cd recommended criteria
Date: Thursday, May 2, 2019 9:55:17 AM
Attachments: [EPA Review of Nebraska's Proposed Recalculation Cadmium Aquatic Life Criteria.docx](#)

From: Elias, Mike
Sent: Thursday, May 2, 2019 7:29 AM
To: Fleisig, Erica <Fleisig.Erica@epa.gov>
Subject: FW: 2016 Cd recommended criteria

From: Elias, Mike
Sent: Friday, September 01, 2017 9:19 AM
To: Bender, John <john.bender@nebraska.gov>
Cc: Lavaty, Ann <Lavaty.Ann@epa.gov>
Subject: RE: 2016 Cd recommended criteria

John,

Thank you for sending the proposed cadmium warm water recalculations for EPA's review. As you requested, we recalculated the criteria values using the same assumptions that you had used, and additionally, provided our thoughts and recommendations regarding the recalculation. The attached writeup provides more detailed feedback, but our general conclusions/recommendations are as follows:

- Using the same assumptions, we calculate the same acute and chronic values as you determined.
- For the calculation of the acute value, however, the 5th percentile is expected to be best represented by the second through fifth most sensitive genera (rather than the first through fourth) and these genera would have been recommended for use in the recalculation. That is because, even with removal of most salmonids, there are still >59 genera in the dataset and the 5th percentile of the distribution is best represented by the second through fifth most sensitive genera. As noted in the attachment, in this case, the change would not result in a different final calculated acute value.
- For the acute value, EPA would also recommend lowering the FAV so that it is protective of the recreationally-important striped bass and other surrogate species (in the genus *Morone*) occurring in Nebraska. Lowering the value based on this consideration would result in a CMC = ~3.0 µg/L cadmium at a total hardness of 100 mg/L as CaCO₃.

- For the chronic value, as you noted, the recalculation results in a value that is more stringent than the nationally recommended 304(a) criterion, so a warm water chronic value should match the EPA recommended CCC of 0.79 µg/L cadmium at a total hardness of 100 mg/L as CaCO₃, unless Nebraska is pursuing more stringent criteria in those waters.

Thank you again for the opportunity to review the recalculated values. Please let me (202-566-0120) or Ann Lavaty (913-551-7370) know if you would like to discuss this further.

Thank you,
Mike

Mike Elias | Biologist

Ecological Risk Assessment Branch | Health and Ecological Criteria Division
Office of Science and Technology | Office of Water
U.S. Environmental Protection Agency
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(202) 566-0120 | elias.mike@epa.gov

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Subject: RE: 2016 Cd recommended criteria

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**EPA's Office of Water/Science and Technology, Health and Ecological Criteria Division
Review of Nebraska's Proposed Recalculation of 2016 Cadmium Criteria for Warm Water
Classification**

August 30, 2017

The following analysis is in response to an email request from Mr. John Bender, Nebraska Department of Environmental Quality, regarding the development of alternate freshwater acute and chronic cadmium criteria for surface waters designated as warm waters by the State. In the email (July 28, 2017), Mr. Bender requested that EPA evaluate a proposed approach for calculating alternate acute and chronic criteria for cadmium and confirm the initial calculations that were included with the communication. The alternate calculation provided by Mr. Bender is intended to update warm water freshwater criteria that were previously-calculated by Nebraska using toxicity data from the 2001 cadmium criteria revision. Both the prior and currently-proposed approaches are based on the removal of most cold water species (primarily salmonids), while retaining species necessary to maintain the eight minimum data requirements (MDRs), as listed in the 1985 Guidelines. Nebraska's recalculation with the 2001 data was noted to have been approved by EPA. The warm water criteria calculations and resulting values (calculated at a total hardness of 100 mg/L as CaCO₃) that are presented with Mr. Bender's email use the same approach as done with the 2001 data, but incorporate the updated toxicity dataset that was used for the revised 2016 national aquatic life criteria for cadmium.

The following sections summarize EPA's evaluation, and include the: 1) Recalculation of criteria using Nebraska's proposed procedure (to confirm the calculations as requested by Mr. Bender), and 2) EPA's evaluation and recommendations related to the methodology proposed by Nebraska for recalculation of the criteria. Both acute and chronic criteria are considered.

Acute Criterion

Nebraska deleted fish from the Family Salmonidae to calculate warm water criteria for the acute recalculation. Consistent with this approach, EPA removed species from the following genera from the Acute Ranked GMAV table for the warm water recalculation, with the exception of one species:

- *Salvelinus sp.* - Bull/Brook Trout
- *Salmo trutta* - Brown Trout
- *Oncorhynchus sp.* - Trout/Salmon
- *Prosopium williamsoni* - Mountain Whitefish
- *Coregonus clupeaformis* - Lake Whitefish

As done by Nebraska, rainbow trout (*Oncorhynchus mykiss*) were retained in the dataset, to satisfy the 8-family MDR requirement. Nebraska then used the four most sensitive genera to calculate the acute criterion.

EPA's calculated acute value is the same as Nebraska's calculated results when the four most sensitive genera were used following the removal of the species/genera, as described above. EPA noted that while the first through fourth most sensitive genera were used in the revised toxicity dataset for the proposed criterion recalculation, the second through fifth most sensitive genera should have been used. Use of the second through fifth genera is consistent with what was done for the national acute criteria calculation to characterize the 5th percentile, and would have been recommended for this recalculation since, even with the removal of most salmonids, there are still >59 genera in the dataset and the 5th percentile of the distribution is best represented by the second through fifth most sensitive genera. Interestingly, this change in the calculation had very little effect on the final values (FAV of 13.764 vs. 13.82), and the CMC remains the same when the values are rounded.

Estimating the 5th percentile using the second- through fifth-ranked genera yields:

- FAV = 13.82 µg/L cadmium at a total hardness of 100 mg/L as CaCO₃
- CMC = 6.9 µg/L cadmium at a total hardness of 100 mg/L as CaCO₃

However, EPA would recommend (consistent with the 1985 Guidelines) lowering the acute criterion to protect the recreationally important species striped bass (*Morone saxatilis*) and potential surrogate species (*Morone spp.*). The lowered recommended value, which is discussed below, then becomes:

- SMAV = 5.931 µg/L cadmium at a total hardness of 100 mg/L as CaCO₃
- CMC = $5.931/2 = 2.96$ or ~ 3.0 µg/L cadmium at a total hardness of 100 mg/L as CaCO₃

EPA's recommends lowering the re-calculated FAV so that it is equal to the SMAV for the recreationally important striped bass, and with consideration of the presence of surrogate species in waters throughout the state. The Nebraska Game and Parks commission lists the striped bass (*Morone saxatilis*), white bass (*M. chrysops*), and the hybrid striped bass, wiper (*M. chrysops* x *M. saxatilis*), as sport fish that can be found in Nebraska (<http://outdoornebraska.gov/fishidentification/>). Nebraska Game and Parks commission also lists the white perch (*Morone americana*) as a non-game fish that can be found in the state. The striped bass can be found in Lake McConaughy and Platte Valley reservoirs, as a coolwater species that does best in larger reservoirs. While it hasn't been stocked in Nebraska waters since the early 1980's, remnant populations of striped bass are reported to still be present. White bass is the most common only native temperate bass in Nebraska and can be found in the Platte and Republican River systems and reservoirs. White bass is one of the top five commonly sought-after sport fish in the state. The wiper, another temperate bass, is stocked in select reservoirs statewide (<http://outdoornebraska.gov/fishidtemperatebass/>). White perch are found in sandpits along the lower Salt Creek and Platte River drainages, lower Platte River and Missouri River, and some southeast reservoirs. NatureServe Explorer lists the white bass as a vulnerable species

occurring in Nebraska, and lists both white perch and striped bass as exotic species not native to the State, but occurring (<http://explorer.natureserve.org/>). Based on the recreational importance of the genus in the State, EPA believes it is warranted to lower the FAV to the SMAV for *Morone saxatilis* and for the other surrogate species in the genus *Morone* for which acceptable toxicity data were not available.

Chronic Criterion

Nebraska deleted fish from the Family Salmonidae to calculate warm water criteria. Consistent with this approach, EPA removed species from the following genera from the Chronic Ranked GMCV table for the warm water recalculation, with the exception of one species:

- *Salvelinus sp.* - Lake/Brook Trout
- *Salmo sp.* - Trout/Salmon
- *Oncorhynchus sp.* - Trout/Salmon

As done by Nebraska, rainbow trout (*Oncorhynchus mykiss*) was retained in the dataset to satisfy the 8-family MDR requirement. EPA's calculated chronic value is the same as Nebraska's when the four most sensitive genera were used. EPA concurs with using four most sensitive genera to represent the 5th percentile, based on the number of genera represented (N=18). This calculation yields the following, consistent with Nebraska's recalculation:

- CCC = 0.76 µg/L cadmium at a total hardness of 100 mg/L as CaCO₃

This approach results in a value that is more stringent than the nationally recommended 304(a) criterion (as noted by Nebraska for their recalculation) so a warm water chronic value should match the EPA recommended CCC of 0.79 µg/L cadmium at a total hardness of 100 mg/L as CaCO₃, unless Nebraska is pursuing more stringent criteria in those waters.

From: [Elias, Mike](#)
To: [Fleisig, Erica](#)
Subject: FW: 2016 Cd recommended criteria
Date: Tuesday, April 30, 2019 8:55:10 AM

From: Bender, John <john.bender@nebraska.gov>
Sent: Wednesday, June 14, 2017 2:33 PM
To: Elias, Mike <Elias.Mike@epa.gov>
Subject: RE: 2016 Cd recommended criteria

Thanks.

John F. Bender
Water Quality Standards Coordinator
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Phone: [REDACTED]



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

MAY 01 2019

Mr. Steve Williams, Administrator
Watershed Assessment and Management Section
Department of Natural Resources and Environmental Control
89 Kings Highway
Dover, Delaware 19901

Dear Mr. Williams:

In accordance with the Clean Water Act (CWA) Section 303(c) and its implementing regulations at 40 CFR §131.20(a), a state shall from time to time, but at least once every 3 years, hold public hearings for the purpose of reviewing applicable water quality standards (WQS), and, as appropriate, modify and adopt revised WQS regulations. The Delaware Department of Natural Resources and Environmental Control (DNREC) held such a public hearing on February 23, 2017. DNREC submitted to the U.S. Environmental Protection Agency (EPA) revised water quality standards on September 5, 2017, and EPA subsequently approved of those revisions on December 11, 2017 in accordance with CWA §303(c)(3). In order to comply with the CWA, DNREC should be prepared to conduct a public hearing by February 2020. As DNREC prepares its next triennial review EPA would like to highlight for DNREC's consideration EPA's most recent 304(a) water quality criteria recommendations that DNREC should consider whether to revise.

EPA 304(a) Criteria Recommendations

A triennial review of a state's WQS regulations provides an excellent opportunity for DNREC and its stakeholders to review DNREC's current numerical criteria for toxic substances in surface waters and determine whether those criteria continue to be protective of designated uses and are based on sound scientific rationale, as required by 40 CFR 131.11(a)(1). In addition, federal regulation at 40 CFR §131.20(a) requires that states provide an explanation if not adopting new or revised criteria for parameters for which EPA has published new or updated CWA Section 304(a) criteria recommendations. This regulation is meant to foster meaningful and transparent involvement of the public and intergovernmental coordination with local, state, and federal entities in light of recent science provided by EPA through its criteria recommendations. EPA will not approve or disapprove this explanation. For Delaware's triennial review, the state will need to provide explanations where new or revised criteria are not adopted for parameters where EPA has published new or updated CWA Section 304(a) criteria recommendations since May 30, 2000, as indicated in the preamble to the final rule *Water Quality Standards Regulatory Revisions* dated August 21, 2015 (80 FR 51020).

In its next triennial review, EPA encourages DNREC to adopt the following criteria for the protection of aquatic life:

- Aluminum (*Aquatic Life Ambient Water Quality Criteria for Aluminum 2018*, EPA-822-R-18-001)
- Ammonia (*Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater*, EPA-822-R-13-001).
- Cadmium (*Aquatic Life Ambient Water Quality Criteria for Cadmium*, EPA-820-R-16-002)
- Nonylphenol (*Aquatic Life Ambient Water Quality Criteria – Nonylphenol*, EPA-822-R-05-005)
- Selenium (*Aquatic Life Ambient Water Quality Criterion for Selenium – Freshwater*, EPA-822-R-16-006).

DNREC should also consider EPA's 2015 the human health criteria updates (Final Updated Ambient Water Quality Criteria for the Protection of Human Health, 80 FR 36986, June 29, 2015). Specifically, we recommend that DNREC consider the following criteria provided below:

Aluminum Criteria

EPA issued revised freshwater aluminum criteria for the protection of aquatic life on December 21, 2018. The updated criteria reflect the latest science that shows that three water chemistry parameters (pH, total hardness, and dissolved organic carbon (DOC)) can affect the toxicity of aluminum by affecting the bioavailability of aluminum in the water to aquatic species. These revised criteria are not fixed acute and chronic values but depend on a site's water chemistry. These criteria use a Multiple Linear Regression (MLR) model to normalize the toxicity data and provide a range of acceptable values. The criteria are calculated based on a site's pH, total hardness and DOC. You can find more information about the 2018 aluminum water quality criteria online at <https://www.epa.gov/wqc/aquatic-life-criteria-aluminum>.

Ammonia Criteria

EPA issued revised ammonia criteria on August 22, 2013. In updating the 1999 ammonia criteria, EPA conducted an extensive literature review that incorporated new toxicity data from 69 studies, including new data on freshwater mussels and gill-bearing snails which are both sensitive to ammonia toxicity. In particular, the freshwater mussels are more sensitive to ammonia than organisms included in the 1999 dataset. You can find more information about the 2013 ammonia water quality criteria online at <https://www.epa.gov/wqc/aquatic-life-criteria-ammonia>.

We encourage Delaware to revise its ammonia criteria in accordance with the recommended criteria, and to ensure that the criteria are implemented in such a manner as to prevent localized toxicity where mixing characteristics could cause less dilution and/or shore-hugging plumes to develop. Ammonia controls to achieve the new criteria would also serve to reduce nitrogen inputs into Delaware estuarine waters.

Cadmium Criteria

EPA issued revised cadmium criteria on April 4, 2016. EPA updated its national recommended cadmium criteria based on the latest scientific information and current EPA policies and methods. The 2016 updated criteria include new data for 75 species and 49 genera not previously represented. The freshwater acute criterion was derived to be protective of aquatic species and further lowered to protect the commercially and recreationally important rainbow trout, consistent with procedures described in

EPA's current aquatic life criteria guidelines; it is slightly lower (i.e., more stringent) than the 2001 acute criterion for dissolved cadmium. The freshwater chronic criterion is slightly higher (i.e., less stringent) compared to the 2001 chronic criterion for dissolved cadmium; this modest increase is primarily due to the inclusion of four new genera, and the reanalysis of other data. The estuarine/marine acute criterion for dissolved cadmium is slightly more stringent than the 2001 recommended criterion, which is primarily due to the addition of new sensitive genera. You can find more information about the 2013 ammonia water quality criteria online at <https://www.epa.gov/wqc/aquatic-life-criteria-cadmium>.

Nonylphenol Criteria

Delaware does not currently have nonylphenol criteria in place, therefore EPA recommends the adoption of EPA's recommended nonylphenol criteria for the protection of aquatic life. EPA issued nonylphenol criteria in December 2005. Most nonylphenol is used in the production of other chemicals, including detergents, lubricants and emulsifiers for agrichemicals. They are persistent in the environment, moderately bioaccumulate and can have estrogenic effects in aquatic organisms.

EPA's recommended criteria includes acute and chronic criteria for both freshwater and saltwater. The freshwater criteria are based on 18 freshwater species and 2 subspecies from 15 genera. The saltwater criteria are based on 11 species from 11 genera. You can find more information about the 2005 nonylphenol water quality criteria online at <https://www.epa.gov/wqc/ambient-water-quality-criteria-nonylphenol>.

Selenium Criterion

Delaware does not currently have selenium criteria in place, therefore EPA recommends the adoption of EPA's recommended selenium criterion for the protection of aquatic life. EPA issued revised the selenium criterion on June 30, 2016. Selenium is a nutritionally essential element for animals in small amounts, but toxic at higher concentrations. Selenium bioaccumulates in the aquatic food chain and chronic exposure in fish and aquatic invertebrates can cause reproductive impairments (e.g., larval deformity or mortality). Selenium can also adversely affect juvenile growth and mortality. Selenium is also toxic to water fowl and other birds that consume aquatic organisms containing excessive levels of selenium.

The 2016 criterion reflects the latest scientific knowledge, which indicates that selenium toxicity to aquatic life is primarily based on organisms consuming selenium-contaminated food rather than by being exposed only to selenium dissolved in water. The final criterion is expressed both in terms of fish tissue concentration (egg/ovary, whole body, muscle) and water concentration (lentic, lotic). You can find more information about the 2016 selenium water quality criteria online at: <https://www.epa.gov/wqc/aquatic-life-criterion-selenium>.

Human Health Criteria

In the 2015 update, EPA revised 94 of the existing human health criteria to reflect the latest scientific information, including updated exposure factor (body weight, drinking water consumption rates, fish consumption rate), bioaccumulation factors, and toxicity factors (reference dose, and cancer slope factor). The criteria follow the current EPA methodology for deriving human health criteria (EPA 2000). EPA also developed chemical-specific science documents for each of the 94 chemical pollutants. The science documents detail the latest scientific information supporting the updated final human health

criteria, particularly the updated toxicity and exposure input values. You can find additional information at: <http://water.epa.gov/scitech/swguidance/standards/criteria/current/hhfinal.cfm>.

Please note that the comments and recommendations contained in this letter are strictly for the DNREC's consideration and do not constitute approval or disapproval decisions under CWA §303(c) and 40 CFR §131.21. Neither are these comments a determination by the EPA Administrator under CWA §303(c)(4)(B) and 40 CFR §131.22(b) that revised or new standards are necessary to meet the requirements of the Act. If you have any questions regarding this letter, please contact me or have your staff contact Denise Hakowski of my staff at 215-814-5726.

Sincerely,

A handwritten signature in blue ink that reads "Michelle Price-Fay". The signature is fluid and cursive, with the first name "Michelle" being the most prominent.

Michelle Price-Fay, Chief
Clean Water Branch
Water Division

cc: David Wolanski (DNREC)